It may be urged by some that the phenomena observed in 1878 may only after all have been equatorial streamers.

It is obvious, therefore, that this point deserves the closest attention during future eclipses, until it is settled one way or the other.

*May* 13, 1886.

Professor G. G. STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

Dr. Walter Lawry Buller (elected 1879) was admitted into the Society.

The following Papers were read:—

I. "On the Structure of Mucous Salivary Glands." By J. N. LANGLEY, M.A., F.R.S., Fellow and Lecturer of Trinity College, Cambridge. Received April 14, 1886.

The cells of mucous salivary glands I have previously described as consisting of a framework or network, containing in its spaces hyaline substance and granules.* I have also mentioned that during secretion the granules disappear from the outer portions of the cells.† A similar disappearance of granules has been found by Biedermann‡ to occur in the cells of the mucous glands of the tongue of the frog.

The granules of the mucous salivary glands are rendered very distinct by irrigating a mounted specimen of a fresh gland with moderately dilute solutions of neutral or alkaline salts. I have generally used sodium chloride solution 5 per cent., and sodium carbonate solution 3 per cent. In these fluids the granules can scarcely be distinguished from small fat globules; those of the submaxillary gland of the dog have a diameter of 1 to 2 $\mu$, those of the orbital gland of the dog are a little larger.

In the resting gland the granules are fairly closely packed throughout the cell, in a line stretching from basement membrane to lumen

* "Proc. Camb. Philos. Soc.," vol. v, p. 25, 1883, and "Internat. Jour. Anat. and Histol.," vol. i, p. 69, 1884.

† "Jour. of Physiol.," vol. ii, p. 276, 1879.

‡ "Wien. Sitzungsb.," Bd. 86, Abt. iii, p. 67, 1882.

there are 8 to 12 granules. After a time the outlines of the granules become indistinct; this takes place much sooner in alkaline than in neutral salt solution.

The reactions of the granules are best observed by irrigating pieces of gland which have been teased out in neutral salt solution. On irrigating with dilute alkalis, dilute mineral acids, or with water, the granules disappear as if they were bubbles bursting. It is difficult, however, to be certain that they are completely dissolved; after treatment with dilute mineral acids, and still more frequently after treatment with water, pale, very slightly refractive masses are seen, apparently consisting of swollen and altered granules. On irrigating with osmic acid the granules swell up considerably, and become less refractive. On irrigating with alcohol or with acetic acid they remain, but are somewhat shrunken.

The hyaline substance of the cells swells up and in part dissolves in 3 per cent. sodium carbonate. The solution forms a viscid fluid; on irrigating with acetic acid or with alcohol a membranous precipitate of mucin takes place. Since the granules are not, for a time at any rate, dissolved by sodium carbonate, it follows that the hyaline substance gives rise to mucin. The granules also give rise to mucin; in most of their reactions they resemble mucin; on solution they form a viscid fluid; further, when a gland is hardened in alcohol, and a section mounted in Canada balsam or in glycerine, the granules in the hyaline substance are usually indistinguishable, both together form the clear mucigen portion of the cells.

During secretion both the hyaline substance and the granules are turned out of the cells; after prolonged secretion the cells consist of an outer zone, chiefly of freshly formed substance, and of an inner zone of network, hyaline substance, and granules, as in the resting state. When the saliva has a high percentage of solids, both the hyaline substance and the granules can be seen in it; such saliva is obtained from the submaxillary gland of the dog by stimulating the sympathetic, and often by strong stimulation of the chorda tympani. The hyaline substance is more soluble than are the granules, and is thus less commonly seen; it is partly dissolved, partly swollen up into a continuous mass; the less swollen parts appear as strings or blebs. The granules in saliva vary greatly in appearance; they may be very slightly swollen, and have fairly sharp outlines; or they may be more swollen and run together, forming pale masses of various size; occasionally in more dilute saliva they are just visible as pale spheres; these are probably the spheres mentioned by Heidenhain,* as seen by him in the submaxillary saliva of the dog after combined stimulation of the chorda tympani and sympathetic nerves.

* "Studien des Physiol. Institute zu Breslau," p. 46, 1868.

Hence then, when a small amount of fluid only is secreted, the hyaline substance and the granules are turned out of the cells without being completely dissolved, when a certain amount more of fluid is secreted the hyaline substance is completely dissolved, and with still more fluid, the granules also are completely dissolved. Some small fat globules are usually turned out of the cells during secretion.

According to Heidenhain,* nerve stimulation causes some constituents of the cell to be converted into a more soluble form, this is usually expressed by saying that mucigen is converted into mucin. Apart from the reasons given by Heidenhain, this is probable, since both hyaline substance and granules appear to be more soluble in osmic acid and in chromic acid when they are in saliva than when they are in the gland cells; but the proof does not seem to me to be conclusive.

Klein† has described the mucous cells as being open towards the lumen, in this I am inclined to agree with him; it is not easy to see in all cells, but in many it is perfectly distinct.

Although I think that the mucous cells are able to turn out bodily their products, I am unable to agree with the view of Heidenhain‡ and of Lavdowsky,§ that the cells disintegrate during secretion. As the decrease in the interfibrillar substance takes place, there is a fresh formation of substance in the outer part of the cells, *i.e.*, as the cell secretes it also grows: the changes which take place are closely comparable to the changes which take place in the pancreas and in other glands, in which there is no question of the disintegration of cells. Moreover, in saliva I can find no evidence of broken down cells; when the cells of a fresh gland are treated with osmic acid the cell membrane becomes very distinct, when sympathetic saliva is treated with osmic acid no signs of cell membrane are found; nor are nuclei present except those in "salivary corpuscles," which, as stated by Pflüger,‖ are leucocytes.

Further, there is not, I think, any satisfactory proof that the demilune cells multiply during secretion, and give rise to mucous cells. I have examined glands at various times after stimulation of the chorda and of the sympathetic, and have not, except extremely rarely, found nuclei undergoing indirect division. As I have previously said,¶ I hold the demilunes to be secreting cells of a different nature from that of the mucous cells, for in different glands all variations are found between glands wholly "albuminous" and

* *Loc. cit.*, p. 108.
† "Quart. Journ. Micr. Science," vol. xix, p. 151, 1879.
‡ *Loc. cit.*
§ Max Schultze's "Archiv," Bd. xiii, p. 281, 1877.
‖ Stricker's "Histology" (translated by Power), vol. i, p. 454.
¶ "Trans. Internat. Med. Congress," 1880.

glands wholly mucous. Glands with demilunes are simply glands in which the "albuminous" element is reduced to a minimum. The apparent increase in size of the demilunes, described by Lavdowsky* as taking place in the first stage of secretory activity, I take to be due to the decrease in the size of the alveoli, so that the ordinarily flat demilunes become more spherical. Moreover, the demilune cells show signs of secretory activity; in the submaxillary gland of the dog after prolonged secretion the demilune cells, in section of the gland hardened in alcohol, are smaller, they stain more readily with carmine, and their nuclei and nucleoli are more conspicuous. The "young" cells described by Heidenhain and by Lavdowsky are, I think, chiefly altered mucous cells.

The network of the cell consists of two parts, one in the cell-membrane, the other stretching from this throughout the cell. The peripheral network is best seen in the isolated cells of the orbital gland of the dog after treatment with chloral hydrate, 2 per cent., for a week to a fortnight. It consists of very delicate fibres; at some of the nodal points there are small spherical swellings. From lumen to basement membrane there are twelve to fifteen meshes. In many cases this network is perfectly distinct, every fibre in it can be followed without the slightest difficulty. In such specimens, on the other hand, it is often difficult or impossible to make out any cell-membrane. That a membrane exists I conclude chiefly from observing cells isolated in sodium chloride, 5 per cent., and then treated with osmic acid. In such specimens the outline of the cells although beaded appears to be continuous. The beading of cell-membrane has been noticed by Schiefferdecker;† it is obvious with most methods of treatment, it is caused by the fibres of the network, seen in optical section.

The internal network is connected with the peripheral network, but it appears to me to have much larger meshes. From basement membrane to lumen there are in the submaxillary gland of the dog four to six meshes, in the orbital gland of the dog five to seven meshes, *i.e.*, the number of meshes in a given direction in the cell is about half that of the number of granules. This network is seen on treating with dilute mineral acids fresh cells which have been teased out in sodium chloride, 5 per cent.; it is seen more or less distinctly in cells treated with the ordinary dissociating agents, and is seen after hardening in various reagents. The reagent which I have found to give most constantly satisfactory results, is a mixture containing 0·3 per cent. of chromic acid and 0·1 per cent. of osmic acid.

The network which I have described above as the limiting network

* *Loc. cit.*

† Max. Schultze's "Archiv," Bd. xxiii, p. 382, 1884.

very closely resembles that described by Klein,* as shown by mucous cells after treatment with spirit or with a mixture of chromic acid and spirit. I cannot, however, find a network with such close meshes beneath the limiting membrane. The passage from the close-meshed limiting network to the wide-meshed internal network can often be traced with a good lens, such as Powell and Lealand's $\frac{1}{12}$ oil-immersion, with angular aperture 1·45.

With certain modes of treatment the cell network is not seen, thus when a piece of gland is hardened in osmic acid and subsequently with alcohol, the cell usually appears to consist of faint granules imbedded in the cell-substance. In such cases the hyaline substance and the network are indistinguishable, and the two together may stain and leave the granules unstained. At any one focus the stained substance will then appear as a close network, and the unstained granules as the meshes of the network. On careful focussing, however, it can be seen that the stained substance is simply the mass of the cell in which the granules are imbedded. This is, I think, the explanation of the close network described by Schiefferdecker† and by Paulsen‡ in certain mucous cells. And that the "network" described by Schiefferdecker is in part the hyaline interfibrillar substance of the cell is indicated by his account of it; according to him it consists of mucigen.

The sublingual gland differs in various respects from other mucous glands; a considerable portion of it consists of "albuminous" cells. According to Klein§ no demilunes are present and the gland tubes have only one layer of cells. This is certainly true of the larger part of the gland; the appearance of two layers of cells in a tube is occasionally caused by the section passing obliquely through a spot where a side tube is given off or where the lumen suddenly alters its calibre. But whilst none of the tubes have a complete double layer of cells, it is I think an open question whether demilunes are absent from the gland. The sublingual gland has been taken as an especially favourable one in which to observe the disintegration of the mucous cells. I do not find that there is any more evidence of disintegration here than there is in ordinary mucous glands. The mucous cells undergo the same changes as do these in the submaxillary of the dog, they discharge hyaline substance and granules, and they form fresh cell-substance. Secretion does not cause any division of nuclei. The "albuminous" cells probably secrete on nerve-stimulation as do the mucous cells; in speaking of these cells as "albuminous" cells I only follow the ordinary usage according to which a secreting cell which is

* "Quart. Journ. Micr. Science," vol. xix, p. 125, 1879; vol. xxi, p. 154, 1882.

† *Loc. cit.*

‡ Max Schultze's "Archiv," Bd. xxvi, p. 307, 1885.

§ "Quart. Journ. Micr. Science," vol. xxi, p. 175, 1882.

granular after a certain mode of treatment is said to be albuminous. It is perfectly possible that such a cell should secrete a substance which is more allied to mucin than to albumin. We do not yet know enough about the chemical characters of the bodies intermediate between proteid and mucin to make any dogmatic statement on this head.

A fuller account of the points dealt with in this paper will shortly be published in the "Journal of Physiology."

## II. "On the Computation of the Harmonic Components, &c." By Lieut.-General STRACHEY, R.E., C.S.I., F.R.S. Received April 15, 1886.

(Abstract.)

The object of this paper is to propose a method of computing the harmonic components of formulæ to represent the daily and yearly variations of atmospheric temperature and pressure, or other recurring phenomena, which is less laborious than the ordinary method, though practically not involving sensibly larger probable errors.

According to the usual method the most probable values of the harmonic coefficients are found by solving the equations of condition supplied from the hourly or other periodical observations, by the method of least squares. The number of these equations is, however, much larger than the number of unknown quantities, when these are limited, as is usual, to the coefficients of the first four orders, and the numerical values of the coefficients of those quantities which depend on a series of sines of multiple arcs, afford peculiar facilities for the eliminating process, so that values of the harmonic coefficients may be obtained by applying certain multipliers to combinations of the original observations obtained by a series of additions and subtractions, the results giving probable errors virtually the same as those got by the method of least squares. These multipliers for the two first orders of coefficients are so nearly equal to $\frac{2}{30}$, and for the third order so nearly 0·07, that the values may readily be found without tables, though such tables have been calculated to facilitate computations.

Approximate methods of determining the coefficients and of the components for each interval of the series, are also given, from which last a graphical representation of the components may easily be obtained.

The system of computation is applicable to all cases in which the angular intervals between the observations are such as to make the circle a whole series, exactly divisible by 6 and 8, and it has been extended, by aid of an interpolation, to the case of the 73 five-day means of a yearly period, in which the calculation by the ordinary